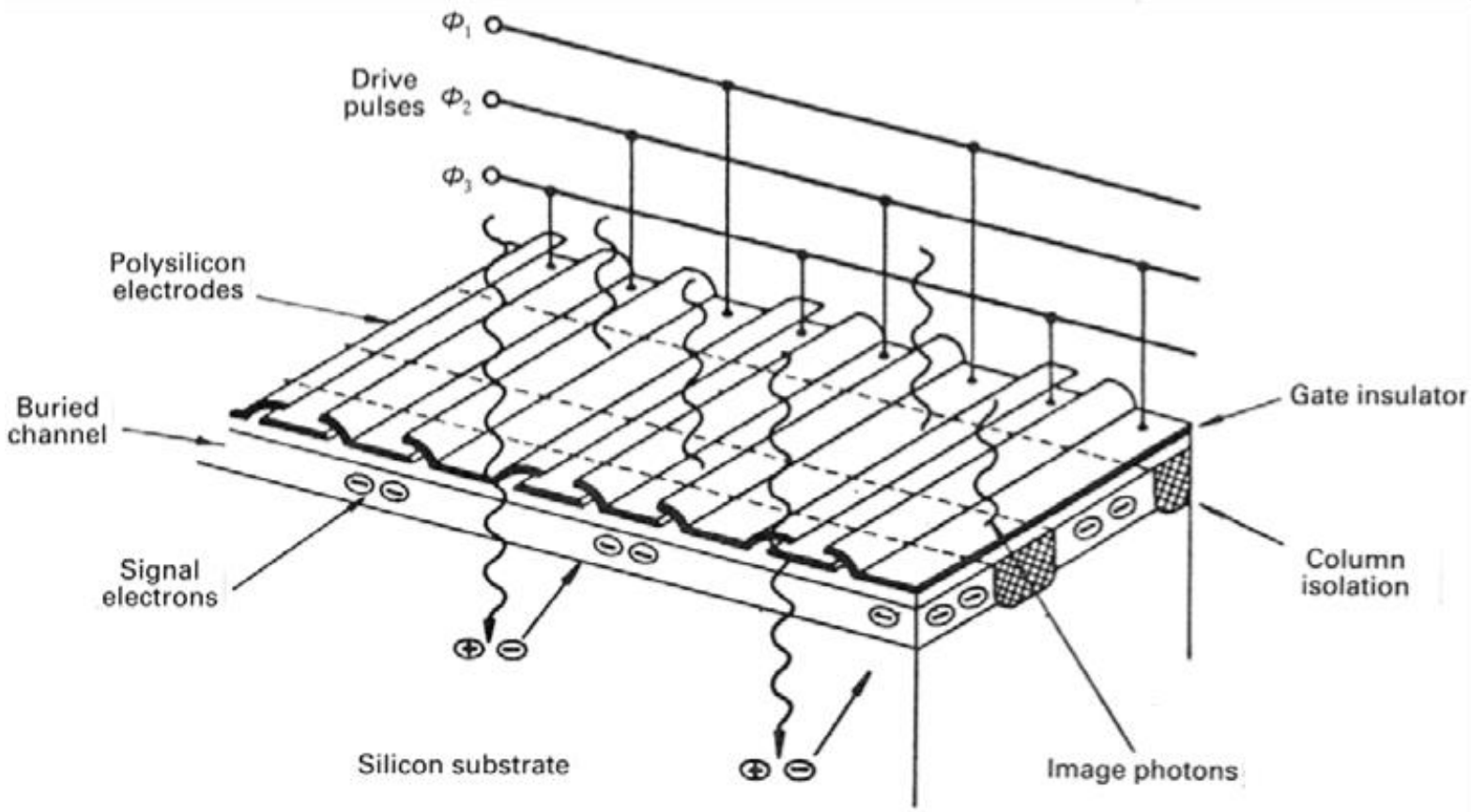
section7_Ex.1&7

2024/09/27

M1 Kensho Tanaka

1. Describe with the aids of diagrams a three-phase surface-channel CCD

- **Three sets of metal electrode strips** are driven by drive pulses, which cause electrons to be transferred.



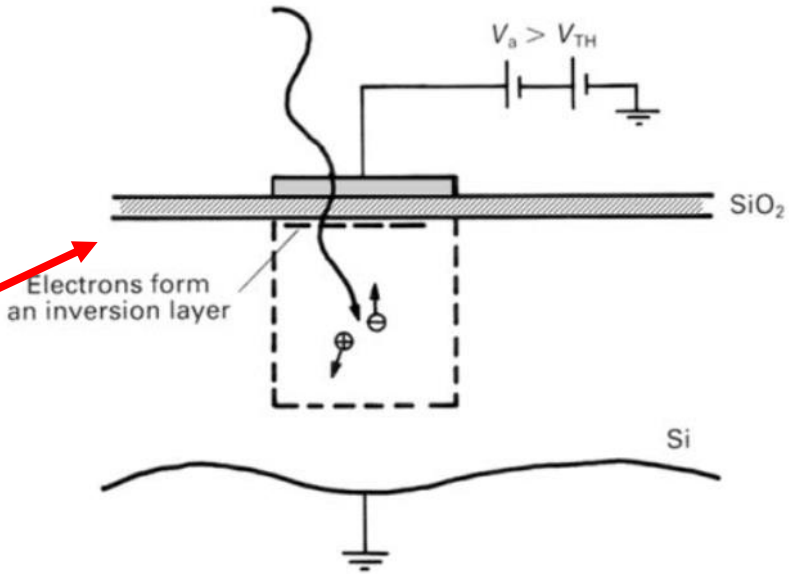
1. Show how photo-generated charges are collected. stored, and transferred to the output

How to collect

- apply the voltage within the layers.
- generated charges (electrons) from the depletion region are trapped within the potential well.

How to store

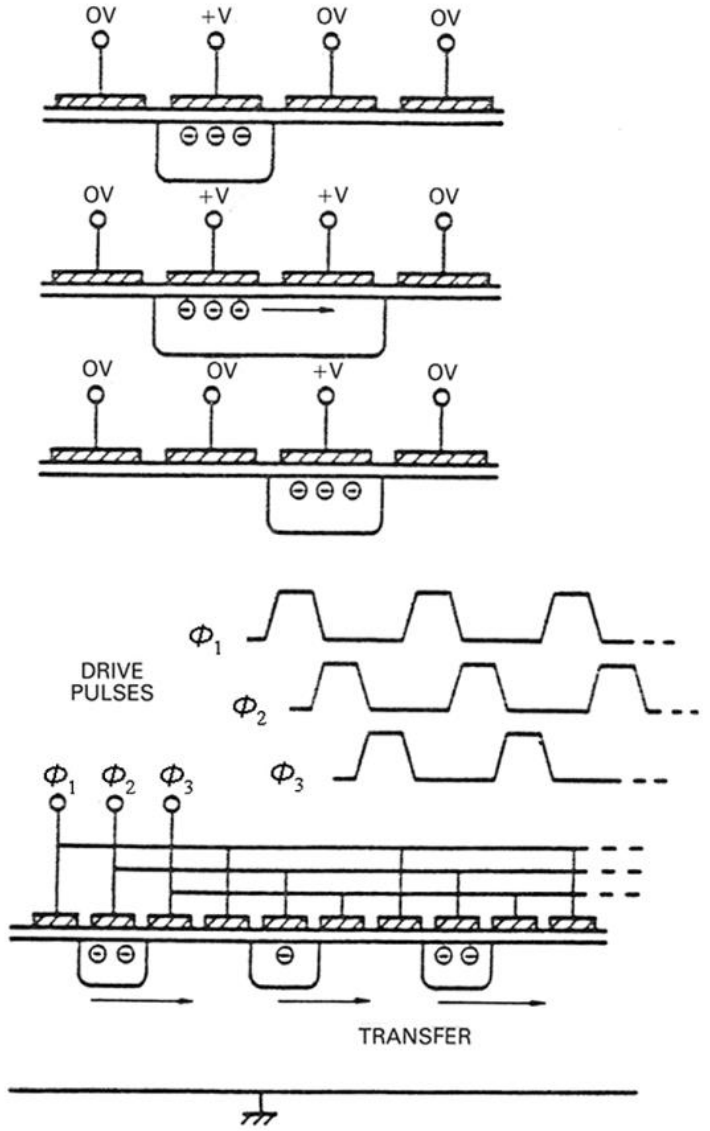
- photo-generated charges are collected within a thin separation layer made from SiO_2



1. Show how photo-generated charges are collected. stored, and transferred to the output

how to transfer electrons to the output

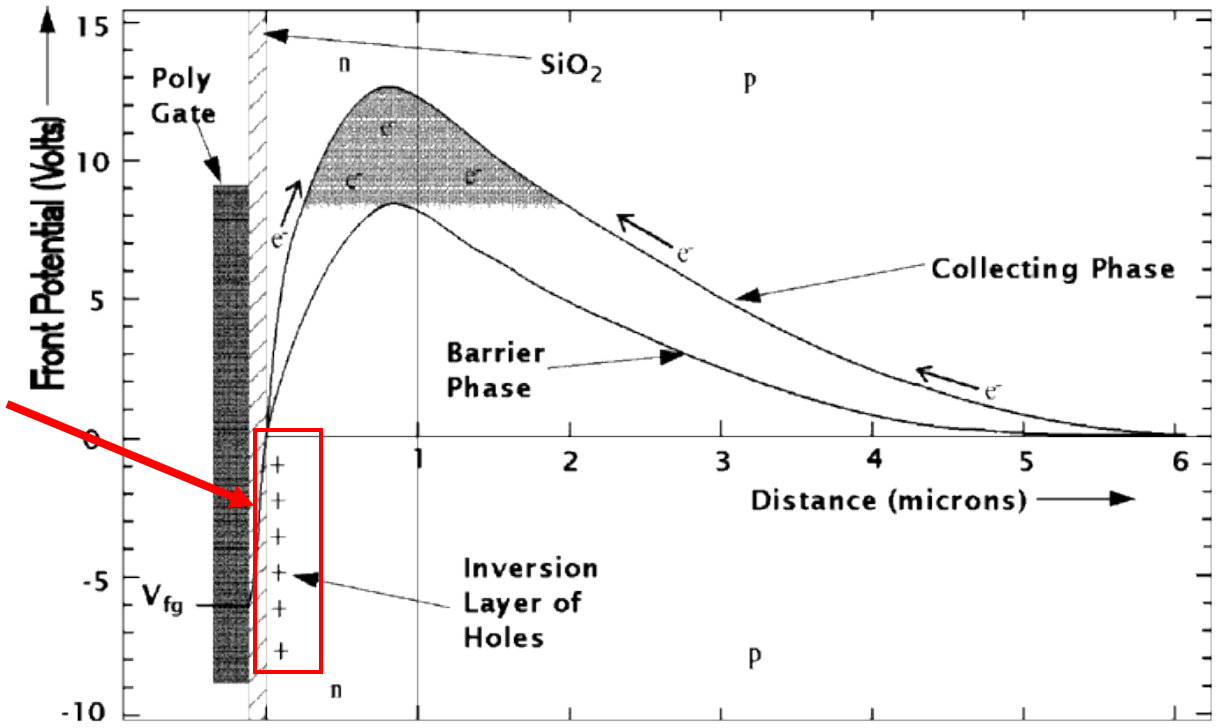
- by means of a timing waveform driven by the different voltage.



7. Briefly explain the operation of a multi-pinned CCD or MPPCCD

- designed in a special way to allow operation in a **totally inverted mode**
- all the gate electrodes are set very negative to the substrate.

- MPP pins the surface potential by populating the Si-SiO_2 interface with holes.
  - eliminating surface dark current by filling the hopping sites.
- electrons are less likely to be captured by the Si-SiO_2 interface, which causes high transfer efficiency.



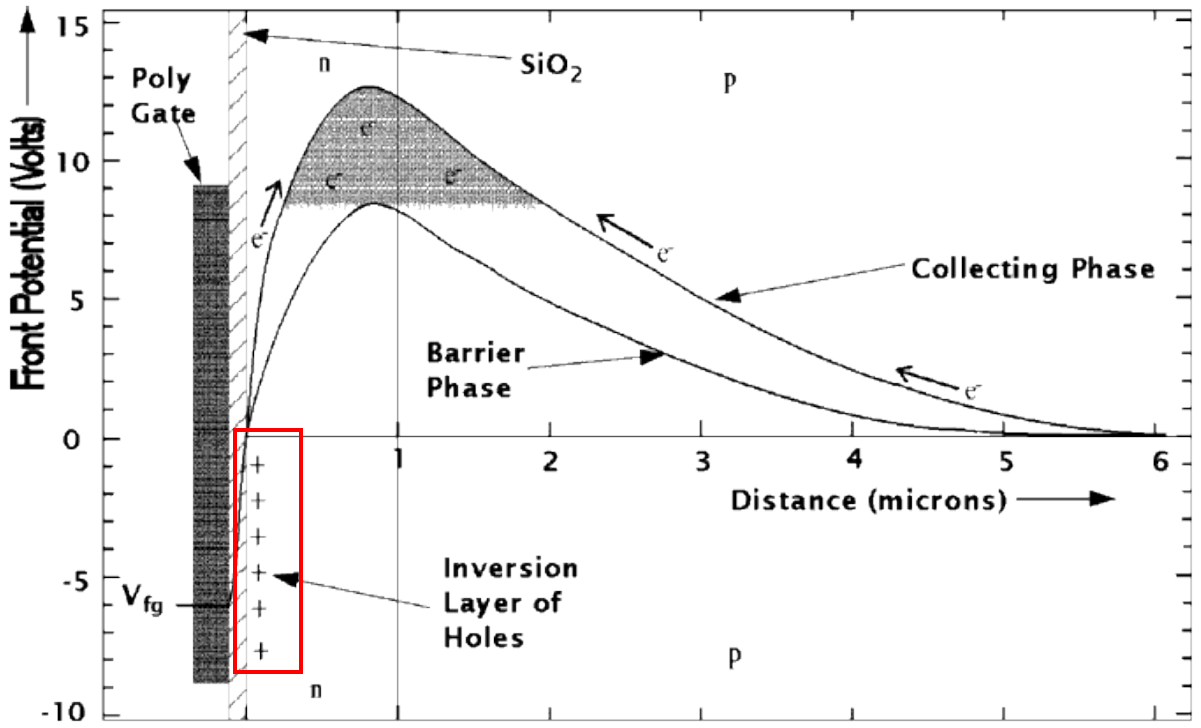
(https://www.stsci.edu/instruments/wfpc2/Wfpc2_hand_current/ch4_ccd2.html)

7. Briefly explain the operation of a multi-pinned CCD or MPPCCD

- MPP pins the surface potential by populating the Si-SiO_2 interface with holes.
  - eliminating surface dark current by filling the hopping sites with holes.

http://www.pi-j.jp/tech_note/html/tmpp.htm

- 電子が価電子帯から中間体、伝導体へ変遷することで暗電流が生じる。
- holeでhopping siteを埋めることで、Si-SiO_2境界面での、電子の帯域間の変遷が減る。 > 暗電流が減る。



(https://www.stsci.edu/instruments/wfpc2/Wfpc2_hand_current/ch4_ccd2.html)